SOUTH CAROLINA
SEA GRANT CONSORTIUM

ANNUAL REPORT
1992-1993

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State Budget And Control Board

S.C. SEA GRANT CONSORTIUM

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Working together to sustain our coastal resources through research, education and extension programs.

October 29, 1993

The Honorable Carroll A. Campbell, Jr., Governor
The Honorable Members of the South Carolina
General Assembly

Your Excellency, Ladies and Gentlemen:

On behalf of the South Carolina Sea Grant Consortium and its Board of Directors, it is my pleasure to present to you the annual report of the S.C. Sea Grant Consortium for fiscal year 1992-1993, our thirteenth year of operation.

We appreciate your continued assistance and cooperation, and look forward to working with you during the next year.

Please do not hesitate to call on us if we can be of service.

Respectfully submitted,

THE S.C. SEA GRANT CONSORTIUM BOARD OF DIRECTORS

Dr. James B. Edwards
Chairman

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The South Carolina Sea Grant Consortium

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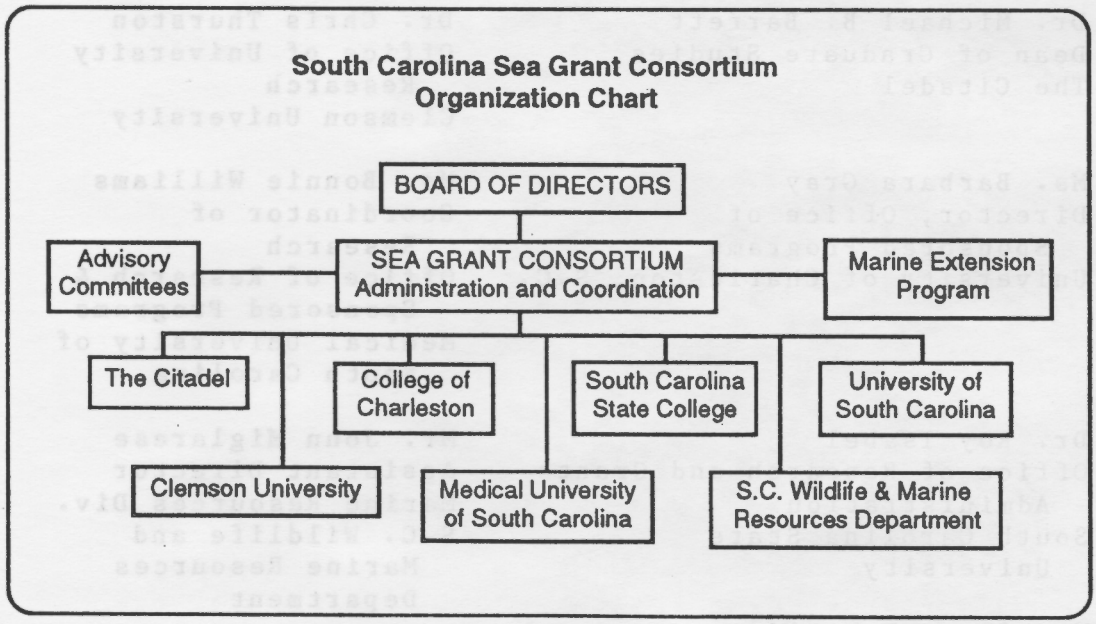


THE SOUTH CAROLINA SEA GRANT CONSORTIUM

Created by South Carolina Act No. 643 in 1978 (amended May 6, 1987, R106, H2331), the principal purpose of the South Carolina Sea Grant Consortium is to provide a mechanism for the development and management of the Sea Grant Program for the state of South Carolina and adjacent regions that share a common environment and resource heritage. The Consortium serves to support, improve and share research, education, training, and extension programs in fields related to ocean and coastal resources. The Consortium further encourages and follows a regional approach to solving problems or meeting needs relating to ocean and coastal resources in cooperation with appropriate institutions, programs, and persons in the region.

Charter Members

The membership of the Consortium consists of the College of Charleston, Clemson University, the Medical University of South Carolina, South Carolina State College, S.C. Wildlife and Marine Resources Department, The Citadel and the University of South Carolina. These members are designated as charter members.

The terms of the membership are perpetual, and a majority of the charter members may vote the admission of a new member into the Consortium.

Board of Directors

The Board of Directors for the Consortium is comprised of the chief executive officer of each of the participating educational institutions and state agencies or his designee.

Executive Director

The Board has the express power to employ the Consortium Director, who has the following powers and duties:

1. directs supervision over all Consortium proposals;
2. prepares Consortium proposals to be submitted to interested agencies;
3. prepares an annual summary of all submitted proposals;
4. negotiates funding levels for proposals submitted by member institutions;
5. provides an accounting to the board of the director's development funds;
6. requests and receives funds from local, state,

federal, and private sources for use by the director, Consortium, individual member institutions, or other persons;

7. gathers, maintains, and makes available to interested persons natural resource information from state and federal agencies, higher education institutions, and any other appropriate entity;
8. designates the location of the consortium office, subject to the approval of the board;
9. exercises all incidental powers necessary to carry out the provisions of this chapter.

Advisory Committee

The Sea Grant Director is to be assisted by an advisory committee which consists of seven members who serve for four-year terms. These seven people, representing private coastal and marine users, are to be appointed to assist the Director with the identification of statewide and regional constituent needs. To date, the advisory committee has yet to be selected and convened.

In addition, program area advisory groups, consisting of research professionals, private sector representatives, and public officals, assist in the identification of research projects and their incorporation into a cohesive program area package.

OVERVIEW

The South Carolina Sea Grant Consortium is a unique partnership of universities, colleges and marine laboratories working to promote and implement research, education and extension programs in the sphere of marine and coastal resources. The Consortium accomplishes these concurrent tasks by drawing on the diverse and extensive talents and expertise available at its seven constituent institutions:

* The Citadel
* Clemson University
* University of Charleston (SC)
* Medical University of South Carolina
* South Carolina State University
* South Carolina Wildlife & Marine Resources Department
* University of South Carolina

The Consortium is charged with bringing together and coordinating the diverse and extensive talents and expertise of its constituent institutions to assist the state in resolving coastal and marine issues. Three

distinct advantages are realized by this "partnership" mechanism:

* Duplication, often a problem in scientific research, is avoided by encouraging cooperation among the different institutions and among different disciplines within the institutions.

* The promotion of manpower sharing results in greater productivity and lower costs.

* The ability to put together teams of faculty and staff from the various member institutions to help solve problems of concern to the state maximizes the effectiveness of existing personnel at the lowest possible cost. Because of this, the South Carolina Sea Grant Consortium office can operate efficiently with a very small staff.

As an independent state agency, the Consortium has expanded its efforts in marine research programs, educational activities, and technical and extension services: it serves as a "broker" between its member institutions and those individuals, industries, and agencies that can benefit from the results of such a range of programs. The emphasis is placed on applied research based upon the needs identified by potential users; the information gained from Consortium activities is then transferred to those users. In other words, the Consortium acts as an information synthesis and dissemination clearinghouse.

The Consortium is responsible for the administration and management of the Sea Grant Program for the state of South Carolina. The National Sea Grant College Program, signed into law in 1966, awards competitive grants to some 31 coastal and Great Lakes states for the express purpose of accelerating the national development of marine resources, including their conservation, proper management, and economic utilization. It is through research, education and extension work that the objectives of the National Sea Grant College Program are implemented and realized.

The Consortium derives its major funding from several sources -- the state of South Carolina, the National Sea Grant College Program and other federal and private funding sources. Through an annual appropriation from the State, the Consortium receives funding to support the staff, program overhead, and the program development fund. The National Sea Grant College Program Office provides funding primarily for full-scale research, education, and extension service projects. This commitment by both the state and the

federal government in supporting the Sea Grant Consortium is representative of the cooperative nature of the Consortium as it addresses coastal and marine resource issues.

The Consortium is guided in its policy decisions at the state level by its Board of Directors. The Board, which consists of the chief executive officer of each of the Consortium's member institutions, meets regularly to review the Consortium's program and to propose new directions for broadening the scope of its activities.

To facilitate administrative interaction between the Consortium and the faculty and staff of its member institutions, each institution has designated a liaison within its Sponsored Research or Financial Office. These liaisons provide a direct link between investigators and Consortium staff on matters dealing with the proposal process, processing of grants and awards, and oversight of ongoing projects and programs.

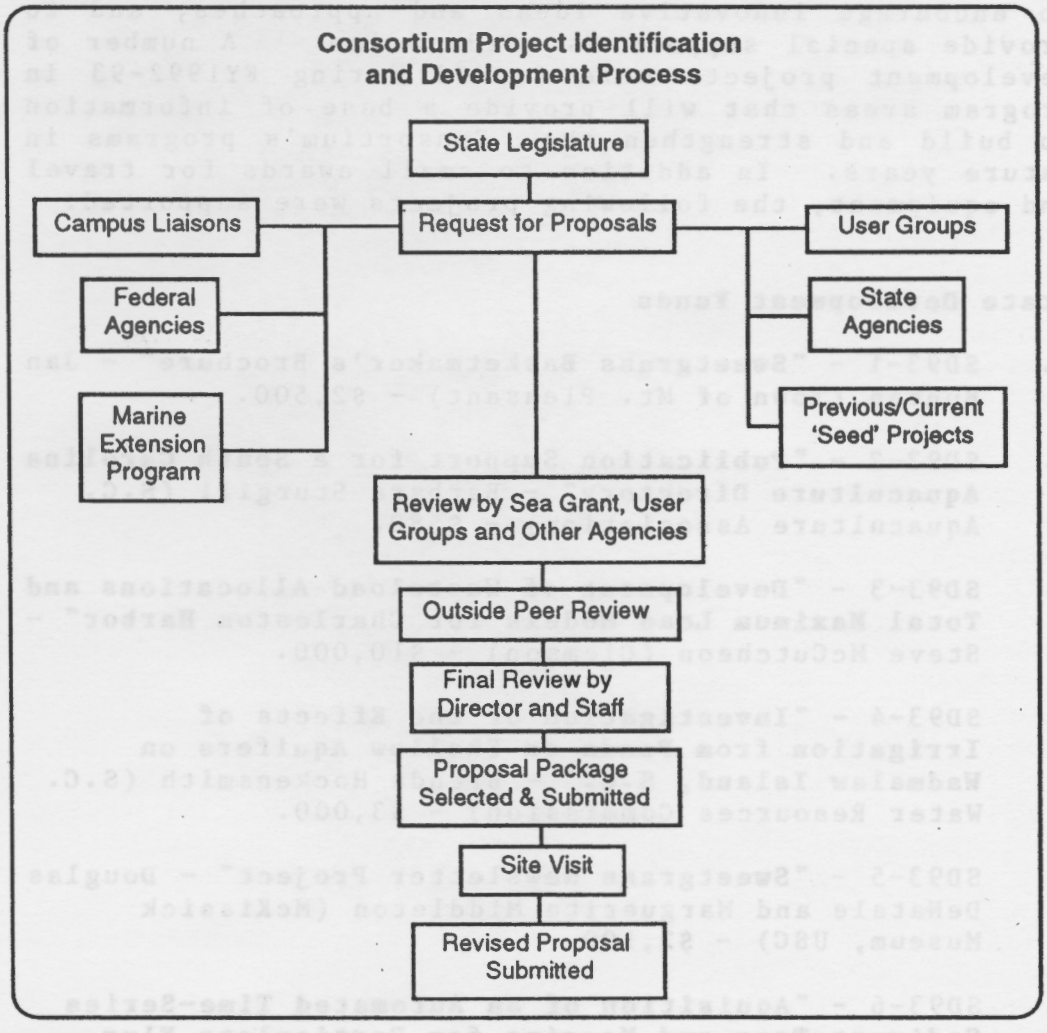
Actual research, education, and extension work on Consortium projects is, of course, carried out by the faculty and staff at the institutions. Their expertise and talent are strengths of the South Carolina Sea Grant Consortium; enabling it to meet the challenge of developing and managing coastal resources in an efficient and comprehensive fashion. Both faculty and staff approach this challenge from the variety of perspectives inherent in their multi-disciplinary fields.

In addition to providing professional expertise in many marine and coastal disciplines, member institutions are able to provide a wide range of facilities for use by Consortium project investigators. These investigators have access to more than 30 research laboratories, including those of the South Carolina Wildlife and Marine Resources Department at Fort Johnson and the James M. Waddell, Jr. Mariculture Research and Development Center in Victoria Bluff, and a large biomedical research facility of the Medical University of South Carolina. Six research vessels are available for field studies. Clemson University possesses the best agricultural engineering facilities for technological development and refinement in the state. Further, among the several field laboratories found throughout South Carolina, the University of South Carolina's 5000-square foot Belle W. Baruch Laboratory in Georgetown County provides a staff of research associates and technicians with a fully equipped facility, including living quarters, and a large conference center.

PROGRAM DEVELOPMENT

General

The South Carolina Sea Grant Consortium has instituted a structured mechanism for its program identification and development process. Program areas are identified by the Consortium staff and program area advisors in consultation with state and federal natural resource agencies, private industry, and Marine Extension Program personnel. The project identification and development process outlined in the chart below is used in the development of the biennial proposal to the National Sea Grant College Program and, generally, for proposals to other funding sources.



For fiscal years 1992-94, the Consortium received some 30 initial proposals in response to its biennial call for proposals. Review of these proposals by qualified professionals from academia, government, and industry throughout the United States via written evaluations and on-site meetings was followed by submission of invited, fully-developed proposals. Sixteen of these proposals were included in the Consortium's FY92-94 biennial proposal package to the National Sea Grant College Program Office for final review and consideration; nine proposals were subsequently funded. These are summarized in the next section.

In addition to federal Sea Grant project support, the Consortium Director is provided federal and state program development funds to allow for program flexibility and prompt response to high priority needs, to encourage innovative ideas and approaches, and to provide special support as needs arise. A number of development projects were funded during FY1992-93 in program areas that will provide a base of information to build and strengthen the Consortium's programs in future years. In addition to small awards for travel and equipment, the following projects were supported:

State Development Funds

1. SD93-1 - **"Sweetgrass Basketmaker's Brochure"** - Jan Bunton (Town of Mt. Pleasant) - $2,500.

2. SD93-2 - **"Publication Support for a South Carolina Aquaculture Directory"** - Barbara Sturgill (S.C. Aquaculture Association) - $580.

3. SD93-3 - **"Development of Wasteload Allocations and Total Maximum Load Models for Charleston Harbor"** - Steve McCutcheon (Clemson) - $10,000.

4. SD93-4 - **"Investigation of the Effects of Irrigation from Ponds on Shallow Aquifers on Wadmalaw Island, S.C."** - Brenda Hockensmith (S.C. Water Resources Commission) - $3,000.

5. SD93-5 - **"Sweetgrass Newsletter Project"** - Douglas DeNatale and Marguerite Middleton (McKissick Museum, USC) - $2,100.

6. SD93-6 - **"Aquisition of an Automated Time-Series Sediment Trap and Mooring for Particulate Flux Studies off the S.C. Coast"** - Leslie Sautter (Univ. of Charleston) - $18,449.

Sea Grant Development Funds

1. P/M-2A - **"Peptide Inducers of Settlement in Oyster Larvae: Important Applications to the Commercial Fishery"** - Richard Zimmer-Faust (USC) - $10,000.

2. P/M-2B - **"Hydrographic Investigations in the North Edisto Inlet"** - Tom Tisue (Clemson) - $8,500.

3. P/M-2C - **"CoastWatch Computer Archive and Distribution Program"** - Mitch Colgan (Univ. of Charleston) - $1,600.

4. P/M-2D - **"Salt Marsh Mortality and Natural Phytotoxins"** - Jim Morris (USC) - $7,000.

5. P/M-2E - **"Enrichment Program for the 1993 for the Lowcountry Science Fair"** - W. Kubinec (College of Charleston) - $1,500.

6. P/M-2F - **"Rapid Multiplication of Sweetgrass Plants"** - Robert Dufault (Clemson) - $3,000.

7. P/M-2G - **"Characterization of Peroxidase Response to Contaminant Exposure in Estuarine Plants"** - Steve Klaine (Clemson) - $7,700.

8. P/M-2H - **"Quaternary Evolution of the Coastal Zone of South Carolina: Climatic and Relative Sea Level Changes Based on Pollen and Plant Fragment Analysis - Phase II"** - A. Cohen (USC) - $2,500.

9. P/M-2I - **"Hydraulic Modeling Study to Reduce Sedimentation in Belle Isle Marina, Georgetown, SC"** - Earl Hayter (Clemson) - $1,000.

10. P/M-2J - **"The Use of Ingress Data and Behaviors to Suggest Possible Transport Mechanisms of Postlarval Penaeid Shrimp"** - A. Shanks (Univ. of Charleston) - $1,800.

11. P/M-2K - **"Natural Products and Immunoprobes for Improving Oyster Larval Set and Enhancing Seed Stock Production in Mariculture and Fisheries Applications"** - Richard Zimmer-Faust (USC) - $2,000.

SEA GRANT PROGRAM DESCRIPTION AND REVIEW

The South Carolina Sea Grant Consortium manages and administers the Sea Grant College Program for the State. As its primary responsibility, the Consortium

develops a program that focuses on institutional research, marine education, and marine extension services. Since 1980, the Consortium has administered over $14 million in federal and state-appropriated funds for over 300 research, education and extension service projects. For the 1992-93 fiscal year, Sea Grant projects were funded at a combined federal-state level of over $1.5 million. More important, however, are the major economic effects accrued to the state, the region, and, in many cases, the nation from these investments.

Institutional Research

Throughout the 1980's, Consortium efforts had been organized into six program areas: Living Marine Resources; Marine Environmental Research; Coastal Resources Development and Management; Bioengineering and Marine Technology; Coastal Processes; and Marine Outreach. A major planning effort was undertaken in 1985-86 with the help of program advisory groups. The results of those discussions shaped the program throughout the remainder of the decade.

However, priority needs within each area continued to fluctuate from year-to-year based on changing resource management and use issues in the state and region. Due to these changes, Consortium program staff convened a planning meeting in the summer of 1991 to re-assess program area emphases and efforts for the next decade. As a result, Consortium program areas have been refocused to deal with contemporary problems and opportunities associated with coastal, estuarine and marine resources in South Carolina:

* Coastal Ocean Studies
* Watershed Dynamics
* Climate and Hazards
* Emerging Technologies
* Sustainable Economic Development
* Marine Outreach

This transition implied a commitment to addressing major needs and concerns of coastal and marine users and managers through objective-oriented, integrated efforts.

This section provides the reader with a brief overview of the nine fully developed proposals supported by program area.

Coastal Ocean Studies

The Coastal Ocean Boundary Interactions and Assessment (COBIA) program is a joint South Carolina Sea Grant Consortium-University of Georgia Sea Grant College Program effort initiated by the Consortium to encourage cooperative, multidisciplinary studies and research within the coastal ocean of the South Atlantic Bight (defined as that region of the Atlantic Ocean which lies between Cape Hatteras, North Carolina and Cape Canaveral, Florida). For the past two years, the South Carolina Sea Grant Consortium has been working with member institutional scientists and staff to organize and implement COBIA.

Scientists, resource managers and educators are working within the COBIA framework to (1) increase communication between and among research institutions and individual scientists, (2) identify research needs in the coastal ocean, (3) initiate new programs of research to fulfill these needs, (4) collect, process and distribute information regionally and (5) effectively incorporate results into future research development and management strategies for the South Atlantic Bight.

COBIA studies will examine the exchange of materials across boundaries in the coastal ocean of the southeastern United States, including sediment-water interfaces, land-water margins and frontal zones. This requires an understanding of the relationships of the physical, chemical, geological and biological systems, and a regional approach to provide a common framework for the coordination of coastal research in the SAB. The general research goals of COBIA include:

* Identification of the processes dominating the coastal ocean of the SAB;

* Quantification of the spatial and temporal variability of these processes; and

* Ultimately, modeling of the exchanges of water, particulates, nutrients, contaminants, energy and organisms across coastal boundaries within the SAB.

COBIA will address five basic and interrelated issues pertinent to the interactive nature of estuarine watersheds and the coastal continental shelf environments. These issues include effects of coastal development, pollution and eutrophication of the coastal zone; fisheries recruitment and dynamics, potential mineral resources management and global

climate change. Each issue encompasses unique political, economic and scientific aspects, and a major goal of COBIA is to develop the necessary scientific basis for effective policy development. COBIA has adopted an approach that examines the exchange of materials across the boundaries in the coastal region of the SAB as the most effective means of achieving this goal.

COBIA is an interdisciplinary initiative that recognizes the interdependence of the physical, chemical, geological and biological systems within the coastal ocean of the SAB. The program takes a regional approach to provide a common framework for the coordination of coastal research in the SAB. The various institutions within the SAB maintain a wide range of research vessels, remote sensing and computing capabilities, and a large inventory of scientific expertise and equipment. An important concept proposed through the COBIA is the pooling of research resources to facilitate cooperative research efforts. COBIA should be viewed as a continuous, dynamic process rather than a stringent, short-term program. Administration of the program is being handled by the S.C. Sea Grant Consortium; a Steering Committee, consisting of representatives of research, science management and funding organizations, is being formed.

A second task of COBIA is the identification of further research needs in the SAB. Initially, COBIA will address the following five broad research objectives, which were developed by a group of 35 marine researchers and managers:

(1) Characterize the CBZ in the SAB with respect to dynamic processes that lead to its stability and role in materials transport and cycling;

(2) Determine the influence of the deep North Atlantic Ocean, particularly the Gulf Stream, on hydrography;

(3) Define and assess the pathways and mechanisms for cross-shelf and long-shore transport of chemicals, particulates, pollutants and organisms;

(4) Examine and model biogeochemical pathways for carbon and other pertinent elements; and

(5) Develop models of the interactions between hydrography, primary and secondary productivity in estuaries and the coastal

zone, and the populations, productivity and recruitment dynamics of marine organisms.

These five research objectives have served as the basis for the initiation of multidisciplinary efforts. Ongoing discussions among COBIA scientists and managers continue to refine the objectives as they address the five COBIA issues, and encompass and complement ongoing research programs in the SAB.

Specific research programs will be designed to couple long-term monitoring with specific sampling designs, and will incorporate modeling as a predictive tool. Modeling also will be used to determine further research needs during the life of COBIA, ensuring that the necessary research objectives are completed.

The identification of specific programs of research and methods of coordinating existing programs is underway in the COBIA research development process. Local meetings throughout the SAB have been and will be convened to address these issues, and a regional conference is planned for Fall 1994. Two workshops (May and December 1991; supported in part by a grant by the NOAA Coastal Ocean Program) involving scientists from Georgia and South Carolina resulted in the creation of four working groups to identify specific research priorities in the SAB. A Directory of COBIA Scientists has been produced as the first step in enhancing communication and interaction among COBIA scientists.

Finally, the development of a SAB communication and database management network has also been identified by researchers and managers as critical to successful regional planning.

Funding support for COBIA studies is being sought from many sources, including the NOAA Coastal Ocean Program, U.S. Geological Survey Coastal Geology Program, U.S. Army Corps of Engineers, Office of Naval Research, U.S. Environmental Protection Agency and others. In addition, the South Carolina Sea Grant Consortium is supporting two COBIA-related projects for Sea Grant support. The Consortium's Coastal Ocean Studies Program is organized into two sections: Coastal Processes and Ocean Processes.

Coastal Processes Subprogram

The coastal zone of South Carolina can be divided into three segments. The morphology of the coast is typically represented as a transition zone between the North Carolina and Georgia coastlines. From the North

Carolina border to Winyah Bay, the Coast is an arcuate strand, with broad sandy beaches, few inlets, well-developed dunes and sparse salt marshes. It is an area which includes a significant tourism and recreation industry in Myrtle Beach, and an industrial base in Georgetown. The southern section of the coast is dominated by a series of barrier islands separated from the mainland by miles of tidal creeks and wide areas of salt marsh. There are few dune systems; rather, tidal inlets are prevalent. Population and industrial growth along this coastal region has remained slow due to these features. However, the numerous barrier and sea islands have attracted vacationers and tourists, and form the hub of the resort industry. The central portion of the coast retains charac-teristics of both the northern and southern sections; it is also the major permanent population center in the South Carolina coastal zone.

The South Carolina coast is fronted by 159 miles of beach (= 10,000 acres) and 40 barrier islands. As a result of coastal storms, rising sea level, and high rainfall and other natural events (including seismic uplift), waterfront property is continually subjected to unpredictable erosion and accretion cycles, inlet migrations, and other physical changes. At the same time, the coast of South Carolina represents an area of primary economic, social and environmental importance. The South Carolina Sea Grant Consortium seeks, in examining coastal process questions, to address the needs of residents who live and work along the coast by providing information on the natural processes that affect their property and livelihood.

Tidal inlets control erosion and accretion cycles and sand budgets along almost the entire shoreline of the South Carolina Bight. Complex offshore bathymetry associated with ebb-tidal deltas causes wide variations in wave energy along the beach and produces irregular patterns of erosion and accretion. A new four-year effort **(R/CP-10 Kana)** was initiated in Fall 1993 to develop a semi-empirical mesoscale model to simulate long-term shoreline changes around tidal inlets in response to natural processes or engineering operations and projects. The model will be of benefit to regulatory agencies charged with evaluating the merits and impacts of inlet projects (such as dredging, rechannelization, etc.) or establishing setback lines for oceanfront development.

Ocean Processes Subprogram

The South Atlantic Bight (SAB) forms a distinct hydrographic and zoogeographic region of the Atlantic Ocean off the coast of the southeastern United States, and borders the Mid Atlantic Bight to the north and tropical waters to the south, lying between Cape Hatteras, North Carolina and Cape Fear, Florida. The offshore boundary of the SAB has not been well-defined, but is often referred to as the western wall of the Gulf Stream or the shelf break which occurs at approximately the 75-meter isobath. The continental shelf throughout the SAB ranges from approximately 50 km in width at Cape Hatteras to approximately 120 km wide at Savannah, Georgia.

Three distinct cross-shelf zones have been identified in the SAB: the inner shelf zone (0-20 meter depth), the mid shelf zone (21-40 meter depth), and the outer shelf zone (41-75 meter depth). The inner shelf zone is characterized by turbid waters resulting from riverine input and has been labeled the Coastal Boundary Zone (CBZ). The mid shelf zone is less responsive to local wind forcing (2 to 14 days), and undergoes seasonal changes in stratification. Conditions in the outer shelf zone are predominantly controlled by interactions with the Gulf Stream frontal zone. Northward propagating meanders and cyclonic frontal eddies affect the outer shelf zone on a time scale of 2 to 14 days, while changes in the mean position of the Gulf Stream axis affect this zone on a seasonal scale.

It has been demonstrated that the SAB functions as a distinctive zoogeographic region of warm-temperate waters and fauna. Cape Hatteras functions as an important barrier to vertebrate and invertebrate fauna and represents the northern boundary of warm-temperate waters on the Atlantic coast of the United States, while Cape Canaveral represents the southern extension of the warm-temperate region where it converges with tropical waters. Numerous studies have characterized the finfish and benthic invertebrate communities within the SAB, and demonstrated that while distinct faunal assemblages are found within the SAB, some exchange of fauna occurs around Cape Hatteras and Cape Canaveral under certain conditions.

Fisheries management is one of the more complex issues within the SAB, due to the intricate relationships which exist between the geological, physical, chemical and biological systems in the region. Fisheries management involves the entire range of boundaries in the SAB from the freshwater-estuarine interface to the

Gulf Stream-shelf water interface in the offshore environment. A primary factor in this complexity is that almost all finfish and shellfish exhibit one or more planktonic stages during their life cycles. In addition, many of the primary food sources of these organisms are planktonic, or depend upon planktonic stages during their life cycles. Planktonic organisms are extremely susceptible to their immediate environment, relying on physical currents to transport them, as well as to transport food and predators to or from them.

Physical, chemical and geological processes play important roles in the population dynamics of finfish and shellfish in the SAB. The interactions of organisms with the various boundaries found throughout the SAB are equally important to fisheries management. Upwelling caused through the interactions of the Gulf Stream with shelf waters and topographic features such as the Charleston Bump provides enhanced primary and secondary productivity in the vicinity of the shelf break. Shallow fronts on the continental shelf may function as regions of aggregation for secondary and tertiary consumers due to concentrated food sources in the SAB. The coastal boundary layer and river plumes may function as both areas of enhanced productivity as well as barriers to transportation into and out of estuarine environments due to physical and osmoregulatory processes. Estuarine fronts serve as temporary, but recurring, sites of aggregation of primary and secondary producers, and may play important roles in the trophodynamics of estuarine organisms. Coastal boundaries are important factors which need to be examined and incorporated into models used for the development of fisheries management strategies within the SAB.

Successful recruitment of larvae is critical to maintain fisheries stocks, but knowledge of annual and spatial variability in populations is limited due to lack of data on the influence of physical and biological factors on recruitment. The overall goal of a three-year project **(R/CO-1 Barans and E. Wenner)** started this year is to determine how spatial and temporal distributions of decapod larvae entrained through an inlet are related to periodic and stochastic events. The investigators plan to test the hypotheses that (1) ingress of postlarvae at the inlet is episodic and enhanced by downwelling favorable winds and spring tides and (2) highest larval abundance in shelf waters surrounding the estuarine entrance occurs during downwelling favorable winds. This work is tied directly to a companion Sea Grant proposal submitted to

the University of Georgia Sea Grant College Program by Drs. Jack Blanton and Peter Verity of Skidaway Institute of Oceanography. Together, the research will increase our understanding of the dynamics, transport and coupling between the estuary and the coastal zone outside the inlet, which should lead to the determination of the potential impact these factors have on postlarval survival.

Watershed Dynamics

Continued interest in the marine and coastal environment is based primarily on its natural resource potential and economic value. Exploitation of the various resources available along the coast has led to increasing demand and competition for the right and access to those resources. Coupled with increased utilization -- e.g., industrial development, agriculture, shipping, fishing, and recreation -- impacts on the marine environment, in one form or another, are inevitable. Encouraging harmony and fostering consensus among all users of the coast and the marine environment must be among the goals of managers responsible for ensuring the wise use and controlled development of the state's natural resources.

The South Carolina Sea Grant Consortium is committed to providing information and data to natural resource agencies and users for use towards minimizing and mitigating environmental effects resulting from these increasing pressures. One major area of concern has been identified by the Consortium -- the study of estuarine systems -- which for the last decade have formed the basis for Consortium research in this program area.

Estuarine Subprogram

Estuaries of the United States are considered one of the most productive ecosystems in the world: significant economic development depends on the maintenance of high quality estuarine systems. Many commercially- and recreationally-important fisheries species spend at least a portion of their life cycle in estuarine environments. Estuaries serve as buffer zones between freshwater riverine systems and the coastal ocean. They receive and process large inputs of freshwater, sediments, nutrients, and other materials that drain from terrestrial-based watersheds. However, the physical, chemical, and biological processes that control these functions are far from being adequately understood.

In a series of planning meetings held over the last five years, estuarine scientists and managers have identified five basic categories of research strategies and management options for U.S. estuaries: water inflows, sediment inflows, nutrients and other chemicals, the coupling of primary and secondary productivity, and fisheries habitat. These areas have been reemphasized in NOAA's Estuarine and Coastal Ocean Science Framework.

The primary focus of the Consortium's Estuarine Subprogram has been the Charleston Harbor Estuary. Charleston Harbor, formed by the confluence of the Ashley and Cooper Rivers, is part of the second largest watershed on the East Coast (Santee-Cooper Watershed = 16,800 square miles). The Harbor is the site of major military, port, industrial, commercial, resort, and residential activities. It has also been influenced by two major engineering projects: diversion of 80 percent of the freshwater flow out of the system and into the Santee River in 1942; and rediversion of 80 percent of these waters back into the system in 1985. As a result, Charleston Harbor Estuary presents a unique opportunity for the examination of a highly-dynamic and heavily-impacted system.

The scope of the Estuarine Subprogram has focused on elucidating the physical and biological nature of estuaries. Consortium efforts have been strengthened through collaboration with the NOS Office of Oceanography and Marine Assessment, which has collected data on current and tide fluctuations through the deployment of RADS technology in the Harbor. The NOAA National Ocean Pollution Program Office supported a Consortium effort to characterize the physical, chemical and biological conditions and trends in Charleston Harbor (as well as Winyah Bay and North Inlet) for the period 1970 to 1985, while additional monies provided through the NOAA Office of Ocean and Coastal Resources Management supported several efforts to characterize the biological, physical and chemical attributes of the estuary from 1985 (after rediversion) to date. In 1991, a NOAA Special Area Management Planning program for Charleston Harbor was initiated.

Previous Sea Grant studies concentrated on the utilization and diet of estuarine habitat by penaeid shrimp, and the influences of physical processes, such as circulation and dispersion, on biological processes. In recent years, the Consortium augmented its efforts by adding two components to further characterize the Charleston Harbor estuarine system. These investigations focus on nutrient dynamics and the response of wetlands to changes in freshwater flow.

The rapid and continued commercial and residential development around the Charleston Harbor Estuary will undoubtedly affect water quality. Human activities and natural processes influence the distribution and dispersion of nutrient elements. The rediversion of the Cooper River with its increased freshwater flow will also modify nutrient inputs. However, little basic information exists on the nutrient dynamics of the estuary, making it difficult for managers to predict the potential water quality changes associated with increased anthropogenic inputs. The final years of an ongoing project **(R/EM-6 McKellar & Blood)** involve completion of a dataset for use in the development of an ecological-water quality model for the Cooper River portion of the estuary, with special emphasis on nutrient and carbon dynamics, sub-basin runoff and wetland exchanges. Objectives for the final two years (92-94) are to (1) quantify the functional roles of an urbanized and a non-urbanized watershed in affecting estuarine water quality (oxygen, organic carbon and nutrients) (2) quantify the functional roles of tidal wetland habitats in modifying estuarine distributions of water quality parameters and (3) facilitate the use of the data in the future development of estuarine water quality models which account for the effects of landuse, nonpoint runoff and wetland exchanges. These efforts will lead also to the integration of resultant information with existing hydrologic, water quality and estuarine ecology models being developed with the support of the Charleston Harbor Special Area Management Plan in collaboration with the Water Resources Division of the U.S. Geological Survey.

The Cooper River rediversion has resulted in a reduction in freshwater discharge from 423 to 130 m/s. As a result of reduced freshwater runoff, the isohalines in the Cooper River portion of the estuary have significantly shifted upstream, resulting in a shift in the boundary between fresh and salt water intertidal wetlands. A new two-year study **(R/ER-8 Morris)** has been initiated, which builds upon an ongoing Sea Grant study (R/ER-7), to examine the effects of the changing salinity regime upon intertidal macrophyte wetland communities. In particular, the investigator proposes to (1) measure the rate of nitrogen metabolism in marsh sediments, (2) measure the productivity of the marsh grass Spartina alterniflora and plant species distributions in intertidal marshes, (3) determine the temporal and spatial variations in the distribution of chloride and sulfide in intertidal sediments and (4) measure DMSP accumulation in S. alterniflora and other marsh macrophytes. This project will offer a means of predicting how macrophyte

communities will change in response to increased salt water intrusion, and how their productivity will be affected during the transition. It will also provide preliminary information necessary to predict longer term effects of sea level rise.

Emerging Technologies

In an increasingly competitive economy, industry spends billions of dollars each year on the research and development of new and better products. Recently, attention has been focused on the exploration of marine sources for these products. Such explorations have been enhanced by the creation of a field of scientific activity called biotechnology. Arising out of new developments in molecular biology and biochemical engineering, advances in biotechnology have allowed scientists and researchers to study biological phenomena as they apply to the manufacturing and service industries. Biotechnology research within the marine environment has focused on the effect of technological processes upon marine organisms and the effect of these organisms and their metabolites upon marine technologies. Already, marine biotechnology research has made significant contributions to the energy, food, pharmaceutical, biomaterial and pollution control industries.

This year, the South Carolina Sea Grant Consortium continued and expanded research efforts to develop molecular biology and biochemical methods, and to identify and characterize substances from the marine environment for use in biotechnological applications.

The capacity to use advanced genetics techniques in the study and manipulation of Mercenaria and other aquaculture bivalves is severely limited by the availability of genetic markers, which comprise the fundamental genetic tools for mapping for selective stock enhancement. A continuing effort **(R/A-23 Hilbish & Showman)** that builds upon previously supported Sea Grant (R/A-22) and NSF work will provide molecular genetic markers (RFLPs), that are essentially infinite in number for all types of genetic mapping. The investigators have completed the construction of cDNA and genome libraries for clams, oysters and mussels for use as molecular probes, and have developed methods for rapid isolation of DNA and fine-tuned molecular techniques for application to bivalve species. Years two and three of the project will involve the characterization of linkage relationships among RFLPs and construct genetic maps and testing the hypotheses that significant differentiation has occurred among

natural populations of the target bivalves at the molecular level and that molecular probes constructed for Mercenaria will cross-hybridize to other bivalve species. Results of this project will, in the long run, provide the genetic tools for advanced genetic methods of selective breeding and a unique molecular genetic resource for research scientists.

Each year hundreds of thousands of tons of a class of nondegradable polymers used in industrial water treatment and detergents and as super-absorbents in sanitary and health care products are released into the environment. The overall goal of a four-year effort **(R/MX-6 Wheeler)** is to identify non-toxic and biodegradable alternatives to the millions of pounds of environmentally and physiologically less acceptable chemicals currently used in these applications. Originally proposed in the Consortium's FY90-92 Program Proposal and highly rated, this project received development fund support over the last two years to begin work. Overall objectives of the proposal are to (1) continue to determine the structure of the soluble mineralization inhibitors isolated from oyster shell and study similar insoluble absorbent proteins from the same source, (2) continue development of synthetic peptide inhibitors for use in various water treatment applications and initiate development of peptide super-absorbents, (3) characterize peptide-crystal interactions in order to develop efficient water treatment polymers and (4) stimulate additional industrial interest in biodegradable peptides. The goal of the research is the development of alternate polymer technologies based on biodegradable polypeptides.

Tumor induction and death are typically used as study endpoints in most environmental toxicology assays. A broadly useful immunotoxicology assay which can measure the biological effects of hazardous compounds well before end-stage pathology would provide a realistic alternative. A new, three-year proposal **(R/EM-7 Burnett)** has been initiated to characterize the cellular basis of the immune response in a marine teleost, using the red drum as the model organism. Specifically, the investigator is (1) developing methods to isolate functional lymphocyte sunsets, (2) defining the cellular requirements for an in vitro immune response, (3) establishing the mechanism by which antigen is recognized, processed and presented to the immune system and (4) characterizing the cellular immune system of gut-associated lymphocytes. The research will provide critical baseline information regarding the cellular basis of the immune response in red drum in order to evaluate whether it might serve as

a sentinel organism for laboratory and environmental immunotoxicology assays.

Sustainable Economic Development

Coastal resource management and economic development issues in South Carolina continue to overwhelm coastal zone planners, resource managers, developers and those involved in commerce, industry, recreation and tourism. The State has an approved Section 306 Coastal Zone Management Program administered by the South Carolina Coastal Council to encourage the preservation and wise development of coastal and marine resources, while providing for orderly economic development. While certain forms of development tend to conflict with federal and state resource protection programs, "sustainable" economic development, which treats natural resources as an integral component of development plans, is being encouraged. This approach also provides for opportunities in rural areas, where natural resources may be the only available "raw material." The Consortium's role is to develop and extend the information and data to support decision-making processes at the state and local level.

The South Carolina Sea Grant Consortium plans to continue examining coastal management issues and exploring appropriate economic development opportunities in cooperation with state and local management agencies and coastal resource users. Research, education and extension projects dealing with production and resource economics, policy, law, regulation, preservation and development of coastal resources will provide the basis for the generation of future Consortium efforts. Needs of the state and region will thus be served simultaneously in terms of decision-making, planning and assessment related to coastal development.

Hybrid Striped Bass Subprogram

The development of aquaculture has evolved slowly in the United States as compared to other countries of the world, where aquaculture plays a significant role in their economies. With growing U.S. consumer desire for seafood exceeding domestic supply, the concept of aquaculture has been gaining national attention. This is true for South Carolina where a variety of species, including hard clams, marine shrimp, crawfish, baitfish (minnows), catfish, and hybrid striped bass, are currently being cultured or examined because of their desirability for aquaculture. The potential for future aquaculture development is greatly enhanced due to the suitability of the climate, physiography, and other features of the state and region.

The South Carolina Sea Grant Consortium has played a pivotal role in developing the State strategy for aquaculture development. Consortium staff coordinated a series of planning meetings and, with the endorsement of the Joint Legislative Subcommittee on Aquaculture, prepared and produced the "Strategic Plan for Aquaculture Development in South Carolina" in January 1989. The Subcommittee has asked the Consortium to oversee the implementation of the Plan's 41 recommendations; an effort that will continue for the next several years.

The South Carolina Sea Grant Consortium continues to aggressively support aquaculture research and extension activities. These efforts directly benefit from the James M. Waddell, Jr. Mariculture Research and Development Center at Victoria Bluff, South Carolina. The Center, which represents a significant commitment by the state to aquaculture, houses state-of-the-art facilities and equipment available to faculty and staff conducting aquaculture research and extension activities. The Consortium works closely with the Center to improve opportunities for the private sector in their aquaculture pursuits.

The aquaculture of finfish has shown great promise in South Carolina, and has been the source of innovative cooperation between the public and private sectors. Indeed, techniques developed and information derived from South Carolina Sea Grant-supported hybrid striped bass research are now being used by culturists in Maryland, North Carolina, Georgia and other states where hybrid bass culture is permitted. Although these states have been involved with the growth of this industry for many years, it has only been since 1988 that it has been legal to commercially culture hybrids in South Carolina. However, in that short time, eight private growers have developed hybrid bass operations. This is due in large part to the information and techniques developed over the last six years through Sea Grant.

The basic methodology for culture of hybrid striped bass has been developed and demonstrated over that time. Although the methods described for producing hybrids appear to be satisfactory, there are a number of areas in which the culture model can be improved to increase efficiency and economic attractiveness. The major objectives of a new two-year effort **(R/A-24 Smith)** are to (1) identify culture requirements and demonstrate improved spawning techniques for the production of white bass (Morone chrysops) "domesticated" broodstock, (2) continue development of

cultured Santee Cooper strain striped bass (M. saxatillis) broodstock and demonstrate improved spawning techniques, (3) produce and evaluate the performance of hybrid striped bass backcrosses and (4) convene a workshop to summarize the status and needs for additional genetic research on striped bass and its hybrids. Results of this research will contribute to the economic growth of the hybrid striped bass culture industry in South Carolina and elsewhere, and will lead to the expansion of the total U.S. production of fingerlings now in limited supply.

Marine Outreach Program

The Marine Outreach Program represents the South Carolina Sea Grant Consortium's overall commitment to provide information to identified constituents, both public and private, concerning sustained use, conservation and management of coastal and marine resources. A well-informed constituency has proven to be essential for wise coastal and marine resource management and sustained economic growth.

Linking information "generators" with information "consumers" through feedback mechanisms of Sea Grant's Marine Outreach Program ensures the timely delivery of research information to a variety of user groups. These interactions manifest themselves in several ways. Contact with formal education systems is focused on providing information to classroom teachers for incorporation into school curricula involving marine, coastal and natural resources. Extension efforts directed to specific user groups involve publications, workshops, booklets and direct contact. Informal education and awareness efforts are also developed for the general public; vehicles for information transfer include brochures, slide shows, group presentations, media interaction and others.

Communications and Information Services

The Communication and Information Services program **(P/M-3 Handal)** of the South Carolina Sea Grant Program supports the agency's overall mission of developing and implementing programs that enhance the conservation, sustained economic development and management of coastal resources, by identifying users of coastal resources and providing them with information to address problems, enhance opportunities and increase awareness of our coastal environment.

Specific goals of the CIS program are to:

* raise statewide awareness of the innerconnectedness of our state's waterways with the coast;
* raise public awareness about the value and dynamic nature of the coastal ocean, as well as our impact upon this resource;
* provide educational products and services to alert coastal constituents to changes in climate and hazards along the coast and how they can appropriately prepare and respond to them;
* identify and promote innovative approaches to appropriate economic development (specifically in the areas of recreation, tourism, and alternative business enterprises) that also contribute tot he sustainable use of coastal resources);
* support through the production and distribution of publications, articles and products information about emerging technology that will have an impact on coastal users and managers;
* enhance the use of marine and coastal resource information in informal and formal educational settings; and
* raise public awareness of the mission, goals and benefits of the S.C. Sea Grant Consortium

Examples of CIS activities over the 1991-92 fiscal year include the following.

Program Awards

The Consortium's quarterly newsletter, Coastal Heritage, received national recognition as the second-place award recipient of the National Association of Governmental Communications (Fall 1991, Winter 1991-92, and Spring 1992 issues).

The 1991 Beach Sweep/River Sweep program set a new state record for the number of volunteers who turned out for the state's largest organized one-day cleanup. Some 7,176 volunteers collected more than 62.5 tons of debris, much of which was recycled. The program was recognized on the state level with a "Take Pride in America" award from Gov. Carroll Campbell and went on to be named a finalist on the national level.

Media Education

During 1991-92, CIS:

* distributed 20 news releases statewide, 4 radio public service announcements, and 4

television features;
* placed an estimated 147 newspaper articles;
* distributed a brochure detailing Sea Grant's mission and work to news media; and
* supplied hurricane preparedness and recovery information, as well as a brochure on the media's role in a disaster, to the New England states hit by Hurricane Bob in the fall of 1991.

Accomplishments in Agency Thematic Areas

During 1991-92, CIS supported the four thematic areas established by the S.C. Sea Grant as follows:

Aquaculture: The potential for growth of the aquaculture industry in South Carolina is great. Sea Grant has always provided substantial support of aquaculture research, extension and information products. Key projects conducted in support of this thematic area over 1991-92 include:

* provided publications and promotional support for the "Conference and Workshop on the Introduction and Transfer of Marine Species" in September 1991, including two brochures and conference proceedings.
* provided publications and promotional support for "Workshop for Hard Clam Watermen" in March 1992.
* reprinted the marine extension publication, Commercial Crawfish Production: A Guide for Prospective Culturists.
* marketed Frontiers of Shrimp Research.
* produced and informational and membership recruitment brochure for the S.C. Aquaculture Association.

Economic Development and Resource Management: A healthy state economy depends upon healthy coastal products. To raise awareness of the value of a healthy coastal environment, CIS undertakes a variety of outreach efforts concerning water quality, wetlands, marine debris, marine animal communities, oceanography, marine plant communities and waterbirds. CIS's goal is to increase public knowledge about the coastal environment and to promote sustained use and management of its resources. To this end, CIS undertook and successfully completed the following activities:

* The 1991 Beach Sweep/River Sweep program, organized by Sea Grant, S.C. Water Resources Commission and S.C. Clean & Beautiful, set new state records for South Carolina's

largest organized one-day cleanup. 7,176 volunteers collected more than 62.5 tons of debris during the Sept. 21 event. Sea Grant earned recognition on the state and national level in the Take Pride in America awards for this program.

* 5,000 watershed posters, targeted toward 5th, 6th and 7th graders were printed and distributed to South Carolina teachers. These posters illustrated, through colorful graphics and text, the innerconnectedness of South Carolina's rivers, lakes, estuaries and the coastal ocean. Half of the printing cost was underwritten as a Beach Sweep contribution by private industry.
* The four issues of the Consortium's quarterly newsletter, Coastal Heritage, published during this fiscal year were devoted to topics dealing with managing our resources for sustained economic growth.
    * The summer 1991 issue was devoted to the idea of conserving our coastal resources from the perspective of tourism, South Carolina's second largest industry. The issue was titled The New Tourism: Blending Development with Community.
    * The fall 1991 issue dealt with the sustainable use of one of our most valuable natural resources, clean drinking water. This topic, titled, Coastal Drinking Water: Good to the Last Drop?, was also the theme for the Consortium's annual mid-winter conference, which provided the general public, as well as water/utility managers with a forum to discuss the future availability and cost of this resource.
    * The winter 1992-92 issue emphasized the value of our coastal ocean and was titled South Carolina's Coastal Ocean: Sustaining our Riches Into the 1990's.
    * The spring 1992 issue, South Carolina's Rural Life: Preserving a Culture, highlighted the richness of our state's rural culture and traditional agricultural industries.
* CIS published three publications on water quality and coastal resources in cooperation with Clemson Extension Service.
* CIS played a significant role on the local arrangements and publicity committees of the

24th Annual International Community Development Conference held in July 1992.

* A CIS staff member participated on the site visit team to Atlantic Beach in October 1991 organized by the S.C. Downtown Development Association.
* CIS promoted two wetlands public forums along the coast.
* CIS reprinted 500 wetlands brochures for distribution to the public.
* CIS Distributed Xeriscape™ manuals to the public.
* In March, a directory of researchers involved with coastal ocean research (COBIA) was published and distributed.

Coastal Processes: Through various publications and promotional outlets, CIS supports research and technology transfer concerning storm, beach erosion, coastal construction, water safety, sediment transport, inlet formation, climate change and sea-level rise. CIS's goal is to increase public knowledge of how coastal processes are integral to life along the shore and should be factored into state country and municipal planning. Activities include:

* Appropriate information about hurricane preparation and recovery was forwarded to the Northeastern states when Hurricane Bob came ashore in the fall.
* CIS produced Vol.II of the Characterization of Physical, Chemical and Biological Conditions and Trends in Three S.C. Estuaries: 1970-1985.
* The slide show, "How to Build A Dune," was shown in various locations around the coastal areas of the state.

Marine Education: S.C. Sea Grant's marine education agenda focuses on school curricula, informal educational opportunities, and volunteer monitoring programs. The two largest ongoing projects in this area, Beach Sweep/River Sweep and the annual mid-winter conference, have been discussed above. In addition to these programs and the accompanying watershed posted described above, CIS also played key roles in marine education by:

* Being represented at educational fairs and festivals around the state, including the Southeastern Wildlife Expo, the S.C. Aquaculture Festival, Earth Day, the S.C. Marine Fishing Fair, the S.C. Shrimp Festival, the LowCountry Fair, and others.

* Provided programs for a variety of school-aged children through library and scouting programs.
* Produced and distributed a consumers' guide to publications produced and distributed by the S.C. Sea Grant Consortium.

Marine Education

The South Carolina Sea Grant Consortium is re-introducing formal marine/coastal education proposals in this FY92-94 Sea Grant proposal cycle that focus on exposing and educating young and disadvantaged students to their cultural and geographic roots and involving teachers in the development and implementation of programs and curricula.

One of the problems facing the science profession is the lack of minority professionals who enter the field. One of the stated reasons for this is the limited exposure to the sciences that these individuals receive when they are most impressionable -- at the grade school level. A two-year study **(E/O-10 Sproatt)** will attempt to increase the number of minority students in the science "pipeline" by providing at-risk minority youth (1) opportunities to use the tools of science in a series of science/ecology summer camps and (2) exposure to coastal environments in a non-threatening setting to promote and encourage their interest in science and coastal studies. The program will be held at the Penn Community Center, and will be host to 60 students during the project. Student follow-up will be undertaken to track the progress of youths after their exposure to the camp environment.

The South Carolina Marine Extension Program

The South Carolina Marine Extension Program (MEP) was reorganized in 1987 to more effectively provide advisory services to the coastal community. In the restructured program, the South Carolina Sea Grant Consortium continues the cooperative arrangement with the Clemson University Cooperative Extension Service (CES). Program direction and oversight are maintained by the Consortium while CES provides the basic extension personnel and work plans to support general constituent needs. Other more specific needs are addressed through specialist projects within Consortium member institutions. This structure allows the MEP to maintain a core unit of permanent personnel under CES while also having the flexibility to contract experts for specific extension needs.

The Marine Extension Program **(A/E-1 Bacon)** has defined five primary program areas to respond to coastal user needs: economic development; water quality and quantity; coastal hazards; education and extension services development. Within these areas MEP activities are targeted toward alleviating problems posed by inadequate understanding of coastal resources and appropriate use technologies, as well as hazards inherent to various uses of the coastal environment. Information delivery is coordinated with the Consortium's Communications and Information Services program.

Recent program accomplishments include: a project to demonstrate fuel savings potential of a new webbing material for commercial shrimp nets; development of a South Carolina Water Trails System in support of nature-based tourism; rapid growth (to almost $1 million annually) of the hybrid striped bass industry; workshops to promote xeriscaping in coastal development schemes; establishment of a volunteer water quality monitoring program in the Charleston Harbor estuary, involving 50 adults and 30 high school students; development of a series of activity handbooks called "Sea Things...Objectively" for grades 1 through 5; and leadership in the S.C. Marine Educators Association. In addition, the MEP works closely with other Sea Grant programs, the SEMAS network, the National Marine Fisheries Service, other state and federal agencies, and others to provide timely delivery of practical information to various user groups and the general public.

The South Carolina Marine Extension Program designs its activities to meet the needs of marine resource users and provides the information necessary to ensure wise and effective use of South Carolina's marine resources. Through MEP's identification of needs, research efforts can be identified and conducted in a responsive and efficient manner. MEP cooperative efforts in the development of new technology and provision of extension services to coastal and marine-related businesses will enhance the sound growth of the economy of South Carolina, as well as sustained management of the coastal resources essential to this growth.

The Marine Extension Program has defined four primary program areas to respond to coastal user needs:

* economic development and resource management
* aquaculture
* coastal processes
* marine education and information services

Within these areas MEP activities are targeted toward alleviating problems posed by inadequate understanding

of coastal resources and appropriate use technologies, as well as hazards inherent to various uses of the coastal environment. Information delivery is closely coordinated with the Consortium's Communications and Information Services program.

The South Carolina Marine Extension Program designs its activities to meet needs of various marine resource users and provides information necessary to ensure wise and effective use of South Carolina's marine resources. Through MEP's identification of needs, related research needs can be addressed in a responsive and efficient manner. MEP cooperative efforts in the development of new technology and provision of extension services to coastal and marine-related businesses will enhance the sound growth of the economy of South Carolina, as well as sustained management of the coastal resources essential to this growth.

Recent program accomplishments include: a project to demonstrate fuel savings potential of a new webbing material for commercial shrimp nets; development of a South Carolina Water Trails System in support of nature-based tourism; rapid growth (to almost $1 million annually) of the hybrid striped bass industry; workshops to promote xeriscaping in coastal development schemes; establishment of a volunteer water quality monitoring program in the Charleston Harbor estuary, involving 50 adults and 30 high school students; coordination of marine 4-H camps; development of a series of activity handbooks called "Sea Things...Objectively" for grades 1 through 5; and leadership in the S.C. Marine Educators Association. In addition, the MEP works closely with other Sea Grant programs, the SEMAS network, the National Marine Fisheries Service, other state and federal agencies, and others to provide timely delivery of practical information to various user groups and the general public.

Service to Other Public Agencies

The South Carolina Sea Grant Consortium has assisted other public agencies with several tasks during FY91-92. The Executive Director continues to chair the Interagency Advisory Staff of the Joint Legislative Aquaculture Committee, which oversaw the development of the "Strategic Plan for Aquaculture Development in South Carolina," coordinated and published by the Consortium.

In early 1990, the Consortium was asked to participate in the development of a State Hazards Mitigation Plan under the auspices of the Governor's Office. The Consortium staff served on the Executive Committee and played a major role in the development of the plan.

In addition, the Consortium Executive Director was invited to contribute to the development of a South Carolina Energy Policy through participation on the Joint Legislative Energy Committee co-chaired by Rep. Harriet Keyserling and Rep. Robert Barber, and served as chair of a subcommittee. The resulting report provided the basis for the development of legislation that was enacted by the General Assembly in June 1992.

Other Grants and Activities

The Consortium supports a variety of programs and activities to meet its goal and objectives. Projects undertaken with Sea Grant support represent the core elements of the Consortium's programs. Pass-through grants and extramural projects are initiated to complement the Sea Grant effort at this time; the future of the Consortium lies in its ability to increase its non-Sea Grant program support.

For fiscal year 1992-1993, the S.C. Sea Grant Consortium obtained funding support from the following organizations for the following activities:

1. **National Sea Grant College Program - NOAA**

   * "Support for Knauss Sea Grant Fellows" - M.A. Davidson (SCSGC) - $60,000.

2. **National Marine Fisheries Service - NOAA**

   * "Support for the Cooperative Institute for Fisheries Molecular Biology (FISHTEC)" - M.R. DeVoe (Project Manager; SCSGC) - $201,000.

3. **Coastal Ocean Program - NOAA**

   * "Feasibility Study to Determine Optimum Methods for Producing COASTWATCH Deliverables in Two South Carolina Environments" - D. Cowan and J. Jensen (University of South Carolina) - $59,405.

   * "The Acute Toxicity and Bioaccumulation of Azino phosmethyl in Benthic Copepods and the Development of a Model for the Trophic Transfer of Non-Persistent Pesticides to Recreationally Important Finfish Species"

- T. Chandler (University of South Carolina) - $41,279.

4. NOAA Fleet

* "Continuation of Sediment - Water Interface Studies (November, 1992 - NOAA Ship FERREL)" - P. Gayes (USC-CCC) - Value = $40,000.

5. National Coastal Resources Research and Development Institute - NOAA

* "Demonstration and Evaluation of the Performance of a Tidal-Powered Upwelling System in South Carolina" - R. Baldwin (Lowcountry Seafood) - $13,076.

6. U.S. Environmental Protection Agency (thru NOAA)

* "Planning a Status and Trends Monitoring Program for the Ecological Resources of the Coastal Zone of the Southeastern United States" - A.F. Holland (SCWMRD) - $79,999.

7. College of Charleston

* "Partial Support of the COBIA Project Manager Position" - M.A. Davidson (SCSGC) - $18,000.

11. City of Charleston - Commissioners of Public Works

* "A Study of Impacts Resulting from Pipeline Installation and Mitigation Efforts on Selected Saltmarsh Ecosystem Components in the Ashley River and Wappoo Creek" - M. Goodwin (SCSGC) - $67,818.

14. Private Funds (misc.)

* "Determination of the Distribution, Abundance, and Status of Colonial Nesting Waterbirds in South Carolina" - T.M. Murray and P.M. Wilkinson (SCWMRD) - $10,742.

* "Support for Hybrid Bass Aquaculture Extension Activities" - T.I.J. Smith (SCWMRD) - $2,500.

* "Support for Beach Sweep '92 Activities" - L. Handal (SCSGC) - $8,000.

ANNUAL ACCOUNTABILITY REPORT

The South Carolina Sea Grant Consortium, in accordance with the requirements of the 1993 Appropriations Act, Section 129.48, has developed the following annual accountability report. These requirem nts were established in Proviso 129.48 of the FY92-93 Appropriations Act and their development was requested in December 1989 and revised September 1993.

Program:

S.C. Sea Grant Consortium - Administration

Program Goal:

Through research, education and extension programs, the S.C. Sea Grant Consortium ensures that coastal and marine issues and opportunities are rigorously researched and understood, and that the resulting information is communicated to those who use and manage these resources.

Program Objectives:

To increase the level of non-state financial support for Consortium programs and activities. To increase the number of faculty, professionals and students supported through sponsored programs and activities. To increase the number of public school science teachers and students exposed to and/or using marine education materials. To service requests received by the Consortium for information on coastal and marine resource issues and opportunities. To deliver information through extension workshops and special programs.

Workload Indicators (FY92-93):

* Amount of non-state funding received.....$1,550,319
* Number of proposals submitted and proposals approved.....29/22
* Number of students supported on projects.....30
* Number of public school science teachers and students exposed to Consortium programs.....3,046
* Number of requests for information received.....6,321
* Number of workshops and special programs.....21

Efficiency Measures (FY92-93):

* Ratio of non-state to state funding.....3.2:1
* Ratio of proposals submitted to proposals approved.....75.9%
* Number of students supported as measured against total available funding.....1:$48,969
* Number of teachers/students exposed to Consortium programs per event.....69
* Number of individuals reached per workshop event.....410

Effectiveness Measures (FY92-93 to FY91-92):

* Change in level of non-state financial support.....+18%
* Change in the number of students supported.....+30%
* Change in the number of teachers and students exposed to Consortium programs.....-12%
* Change in the number of requests for information by the Consortium.....+24%
* Change in the number of attendees at workshops and special programs.....-0.3%

Fiscal Reports

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Exhibit A

S.C. Sea Grant Consortium
Statement of Changes in Current Operating Funds
Year Ended June 30, 1993

	Administration	
Balance July 1, 1992		200
Additions:		
Preliminary Appropriation	502,206	
Allocation for Base Pay Increase	3,176	
Total Additions		505,382
Deductions:		
B&C Mandated Reductions	19,843	
Expenditures	483,139	
Total Deductions		502,982
Balance Due to the General Fund		2,600

Exhibit A-1

S.C. Sea Grant Consortium
Schedule of Current Operating Funds
Year Ended June 30, 1993

	Original Approp.	Revised Approp.	Expend.	Balance
Personal Services	$272,079	$263,707	$263,707	$ -0-
Contractual Services	51,191	25,325	24,552	773
State Development	40,000	36,750	36,589	161
Supplies	14,046	14,251	14,244	7
Fixed Charges	49,002	57,330	57,330	-0-
Travel	10,814	19,114	17,664	1,450
Equipment	599	555	554	1
Light, Power, Heat	4,200	3,930	3,924	6
Transportation	1,000	450	449	1
Employer Contributions	59,275	64,127	64,126	1
Total	$502,206	$485,539	$483,139	$ 2,400

Exhibit A-2

S.C. Sea Grant Consortium
Schedule of State Development Funds
Year Ended June 30, 1993

Title	Grantee	Funds
Sweetgrass Baskets	PRT	$2,500
Aquaculture Directory	WAS	580
Non Point Source Pollution	Clemson	10,000
Groundwater	Citadel	3,000
Sweetgrass Newsletter	USC	2,060
Geology Equipment	CofC	18,449
Total		$36,589

Exhibit B

S.C. Sea Grant Consortium
Statement of Changes in Restricted Funds
Year Ended June 30, 1993

	Balance 7/1/92	Total Additions	Total Deductions	Balance 6/30/93
Sea Grant				
1988-89	$ <70>	$ 70	$	$
1990-91	1,431	223	1,669	<15>
1991-92	<82,067>	435,277	358,772	<5,562>
1992-93		410,582	474,502	<63,920>
Other Federal Funds	3,999	204,115	303,065	<94,951>
Other Restricted Funds	131,681	130,422	113,338	148,765
Total	$ 54,974	$1,180,689	$1,251,346	<$15,683>

Exhibit B-1

S.C. Sea Grant Consortium
Statement of Changes in Other Federal Funds
Year Ended June 30, 1993

	Balance 7/1/92	Total Additions	Total Deductions	Balance 6/30/93
Headstart for Science	$ -0-	$ 11,770	$ 11,898	$ <128>
COBIA	361	22,986	24,014	<667>
Benthic Copepods I	<14,919>	27,474	12,554	1
NCRI	3,919	18,000	19,327	2,592
NCRI Upwelling	14,291	6,000	11,835	8,456
Benthic Copepods R/COP-4	-0-	23,621	23,620	1
E-MAP	-0-	5,518	5,518	-0-
Benthic Copepods II	-0-	-0-	35,635	<35,635>
Public Inv. Slide Show	-0-	5,128	5,128	-0-
Fish Tec I	-0-	1,368	8,266	<6,898>
Fish Tec II	-0-	69,247	132,318	<63,071>
Fish Tec III	-0-	13,003	13,002	1
EPA	<50>		<50>	-0-
ACOE	397			397
Total	$ 3,999	$204,115	$303,065	$<94,951>

Exhibit B-2

S.C. Sea Grant Consortium
Statement of Changes in Other Restricted Funds
Year Ended June 30, 1993

	Balance 7/1/92	Total Additions	Total Deductions	Balance 6/30/93
Sale of Assets	$ 514	$ 50	$ 514	$ 50
Bird Guide	18,290	2,500		20,790
Beach/River Sweep	4,562	8,571	9,886	3,247
Comm Reprints	4,533	1,196	17	5,712
PICMD	9			9
Recycling Guide	173			173
CPW Pipeline	15,087	65,000	54,013	26,074
Hybrid Bass Wkshp	232			232
Donations - Misc	2,533	500	550	2,483
Marine Species Conf.	2,633	3,000	2,132	3,501
Misc Research	5,400		2,534	2,866
NPS Information	<455>	5,071	4,616	-0-
WR4 Integrated Educ	7,502		3,611	3,891
C of C Sautter	2,139	18,709	18,865	1,983
Headstart for Science	3,000		3,000	-0-
S.C. Humanities/500 Yrs.	3,160	2,784	5,694	250
Coastal Society		2,000	1,755	245
A/E-1A2 Bin Boards		300		300
Hybrid Bass Donation	62,361	10,741	6,151	66,951
PRT-Folly Beach	8			8
COP-Bouy		10,000		10,000
Total	$131,681	$130,422	$113,338	$148,765

Exhibit C

S.C. Sea Grant Consortium
Statement of Changes in Fixed Assets
Year Ended June 30, 1993

	Balance 7/1/92	Additions	Retirements	Balance 6/30/93
Capital Equipment	$143,855	$ 6,641		$150,496
Motor Vehicl Equip	13,504			13,504
Total	$157,359	$ 6,641		$164,000

Exhibit D

S.C. Sea Grant Consortium
Notes to Financial Statements
June 30, 1993

Note 1 - Summary of Significant Accounting Policies

Basis of Accounting:

The financial statements have been prepared on an accrual basis.

Funding Accounting:

To ensure observance of limitations and restrictions placed on the use of resources available to the Consortium, the accounts are maintained in accordance with the principles of fund accounting. This is the procedure by which resources for various purposes are classified for accounting and reporting purposes into funds that are in accordance with specified activities or objectives. Separate accounts are maintained for each fund.

General Fixed Assets:

Fixed assets are recorded as expenditures of the general operating fund upon acquisition and subsequently capitalized at actual cost in the general fixed asset account group. In accordance with generally accepted accounting principles prescribed for governmental funds, a provision for depreciation of general fixed assets is not recorded.

Grant Accounting:

The Consortium is a State agency involved in ocean and coastal research, education, and advisory extension work. It serves to encourage, coordinate and facilitate projects pertaining to coastal and ocean areas of South Carolina and to utilize the talents of its members to address marine issues and opportunities.

The Consortium identifies these projects through planning and priority setting exercises. The Consortium arranges for the design and implementation of the projects, usually through its member institutions. On a biennial basis, core projects are submitted to the National Sea Grant Program for funding. Additionally, the Consortium submits project proposals to federal, state and private funding agencies for consideration and support. A majority of the projects funded are then subcontracted to various member institutions.

Expenditures paid by the Consortium at June 30 and not yet reimbursed by the primary grantor are recorded as accounts receivable. Revenues received on specific grants which are in excess of expenditures are recorded as deferred revenues.

Note 2 - Retirement Plan

Substantially all employees of the Consortium are covered by a retirement plan through the South Carolina Retirement System. It was not feasible to separately identify current year retirement plan cost included as a portion of employer contributions in the accompanying financial statements.

Information regarding the excess, if any, applicable to the Consortium of the actuarially computed value of vested benefits over the total of the pension fund and any balance sheet accruals, less any pension prepayments of deferred charges is not available. By State Law, the Consortium's liability under the retirement plan is limited to the amounts appropriated therefore in the South Carolina Appropriation Act, plus the amount paid from other revenue sources for the current year. Accordingly the Consortium recognizes no contingent liability for unfunded costs associated with participation in the plan.

Note 3 - Contingent Liabilities

The Consortium has numerous contracts with the Federal Government, other State agencies and other funding sources for the reimbursement of specific costs related to the various programs described in each contract. Reimbursement costs subsequently deemed to be unallowable by the grantor, if any, would have to be repaid. A majority amount of the contracts are in turn subcontracted by the Consortium and reimbursed costs deemed to be unallowable would result in a claim by the Consortium against the subcontractor.

Total Number of Documents Printed	154
Cost Per Unit	$ 2.67
Printing Cost - S.C. State Budget & Control Board (up to 255 copies)	$ 411.14
Printing Cost - Individual Agency (requesting over 255 copies and/or halftones)	$
Total Printing Cost	$ 411.14